1120.41059X00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: J. RUUTU, et al

Serial No.: Not yet assigned

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For: PACKET FLOW CONTROL METHOD AND DEVICE

Group: Not yet assigned

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

December 28, 2001

Sir:

Prior to examination, please amend the above-identified application as follows.

IN THE CLAIMS

Please amend the claims as follows:

1. (Amended) A method of controlling a data packet flow in a buffer means of a network node of a data network, said method comprising the steps of:

(a) assigning a nominal capacity to each data flow; and

(b) shifting free capacity from a first flow portion to a second flow portion, when a new data packet of said second flow portion has been received at said buffer means and said nominal capacity has been exceeded.

2. (Amended) A method according to claim 1, wherein said nominal capacity is an upper buffer memory limit of a buffer memory of said buffer means shared between a plurality of channels allocated to respective packet data connections and determined in dependence on the number of allocated channels, and wherein memory space is shifted from said first channel to a second channel, when a new data packet of said second channel has been received and not enough memory space is available for said second channel.

4. (Amended) A method according to claim 2, wherein said second channel is a new channel set up for a new packet data connection.

5. (Amended) A method according to claim 2, wherein said second channel is a channel having reached its upper buffer memory limit.

6. (Amended) A method according to claim 5, wherein a channel with the longest packet queue is selected as said first channel, and a predetermined data packet is dropped from the queue of said first channel, when no free memory is available in said buffer memory .

8. (Amended) A method according to claim 6, wherein said dropping of said predetermined data packet is inhibited and said new data packet is dropped, if the queue of said second channel has reached said upper buffer memory limit.

9. (Amended) A method according to claim 8, wherein said channel with the longest packet queue is determined by an estimation.

11. (Amended) A method according to claim 10, wherein said buffer means is a PDCP buffer .

12. (Amended) A method according to claim 11, wherein said packet data connections are connections between mobile terminals (MT1-MTn) and Internet hosts (H1-Hn), or between mobile terminals.

15. (Amended) A method according to claim 14, further comprising the step of admitting a new data flow only if the nominal flow rate of said new data flow falls within the remaining system bandwidth.

17. (Amended) A method according to claim 16, wherein said method is used in a QoS scheduling algorithm for scheduling concurrent user traffic.

20. (Amended) A method according to claim 18, wherein said first and second flow portions belong to different data flows scheduled on the same round.

21. (Amended) A method according to claim 18, wherein said first and second portions belong to the same data flow, and said first flow portion is scheduled on a round following the round of said second flow portion.

22. (Amended) A method according to claim 18, wherein said first and second flow portions belong to different data flows, and said first flow portion is scheduled on a round following the round of said second flow portion.

23. (Amended) A method according to claim 22, wherein said nominal flow rate is determined based on the following equation:

$$NR_i = \alpha \text{ x } Cr_i$$

wherein α denotes a fractional value defining a tradeoff between an overall packet loss ratio and a system throughout, NR_i denotes a nominal flow rate assigned to a concerned user data flow i, and Cr_i denotes a contracted data rate for said concerned user data flow i.

24. (Amended) A method according to claim 23, wherein an urgency factor is assigned to each data packet, and the target flow for said shift of said free capacity is determined based on said urgency factor.

25. (Amended) A method according to claim 23, wherein an accumulated residual bandwidth is determined for each data flow, and the target flow for said shift of said free capacity is determined based on said accumulated residual bandwidth.

26. (Amended) A method according to claim 25, wherein arriving data packets are segmented into data segments and scheduling is performed at the data segment level.

27. (Amended) A network for controlling a data packet flow in a buffer means of said network node, wherein said network node comprises flow control means for assigning a nominal capacity to each data flow, and for shifting free capacity from a first flow portion to a second flow portion when a new data packet of said second flow portion has been received at said buffer means and said nominal capacity has been exceeded.

28. (Amended) A network node according to claim 27, wherein said buffer means comprises a buffer memory shared between a plurality of channels allocated to respective packet data connections; and said flow control means comprises buffer control means for determining an upper buffer memory limit for each channel in dependence on the number of allocated packet data connections and for controlling allocating means so as to shift memory space allocated to a first channel from said first channel to a second channel, when a new data packet of said second channel has been received and not enough memory space is available for said second channel.

29. (Amended) A network node according to claim 28, wherein said buffer control means is arranged to determine said upper memory limit by dividing the total buffer memory capacity by the number of allocated channels.

30. (Amended) A network node according to claim 28, wherein said buffer control means is arranged to select a channel with the longest packet queue as said first channel and to control said allocating means so as to drop a predetermined data packet from the queue of said first channel when no free memory is available in said buffer memory.

31. (Amended) A network node according to claim 30, wherein said buffer control means is arranged to inhibit said dropping of said predetermined packet and to control said allocating means to drop said new data packet, if the queue of said second channel has reached said upper buffer memory limit.

32. (Amended) A network node according to claim 30, wherein said buffer control means is arranged to estimate said channel with the longest packet queue by storing the length and identity of the last determined longest queue, to compare the length of a current queue with said stored longest queue on a queuing event, and to update the length and identity of said stored longest queue according to the result of comparison.

33. (Amended) A network node according to claim 32, wherein said buffer memory is a PDCP buffer .

34. (Amended) A network node according to claim 27, wherein said flow control means comprises scheduling means and said nominal capacity is a nominal flow rate at which data flow traffic is guaranteed in a QoS scheduling algorithm.

35. (Amended) A network node according to claim 34, wherein said scheduling means comprises said buffer means.

36. (Amended) A network node according to claim 35, wherein said network node is a radio network controller .

Please add new claims 37-44 as follows:

-- 37. A method according to claim 3, wherein said second channel is a new channel set up for a new packet data connection.

38. A method according to claim 3, wherein said second channel is a channel having reached its upper buffer memory limit.

39. A method according to claim 7, wherein said dropping of said predetermined data packet is inhibited and said new data packet is dropped, if the queue of said second channel has reached said upper buffer memory limit.

40. A method according to claim 19, wherein said first and second flow portions belong to different data flows scheduled on the same round.

41. A method according to claim 19, wherein said first and second portions belong to the same data flow, and said first flow portion is scheduled on a round following the round of said second flow portion.

42. A method according to claim 19, wherein said first and second flow portions belong to different data flows, and said first flow portion is scheduled on a round following the round of said second flow portion.

43. A network node according to claim 29, wherein said buffer control means is arranged to select a channel with the longest packet queue as said first channel and to control said allocating means so as to drop a predetermined data packet from the queue of said first channel when no free memory is available in said buffer memory.

44. A network node according to claim 31, wherein said buffer control means is arranged to estimate said channel with the longest packet queue by storing the length and identity of the last determined longest queue, to compare the length of a current queue with said stored longest queue on a queuing event, and to update the length and identity of said stored longest queue according to the result of comparison. --

REMARKS

Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The attached page is captioned "**Version with markings to show changes made**".

Entry of the above amendments prior to examination is respectfully requested.

Please charge any shortage in fees due in connection with the filing of this paper, or credit any overpayment of fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (1120.41059X00).

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please amend the claims as follows:

1. (Amended) A method of controlling a data packet flow in a buffer means ~~(13; 14)~~ of a network node of a data network, said method comprising the steps of:

~~(a)~~(c) assigning a nominal capacity to each data flow; and

~~(b)~~(d) shifting free capacity from a first flow portion to a second flow portion, when a new data packet of said second flow portion has been received at said buffer means ~~(13, 14)~~ and said nominal capacity has been exceeded.

2. (Amended) A method according to claim 1, wherein said nominal capacity is an upper buffer memory limit of a buffer memory ~~(13)~~ of said buffer means shared between a plurality of channels allocated to respective packet data connections and determined in dependence on the number of allocated channels, and wherein memory space is shifted from said first channel to a second channel, when a new data packet of said second channel has been received and not enough memory space is available for said second channel.

4. (Amended) A method according to claim 2 ~~or 3~~, wherein said second channel is a new channel set up for a new packet data connection.

5. (Amended) A method according to claim 2 ~~or 3~~, wherein said second channel is a channel having reached its upper buffer memory limit.

6. (Amended) A method according to claim 5 ~~any one of claims 2 to 5~~, wherein a channel with the longest packet queue is selected as said first channel, and a predetermined data packet is dropped from the queue of said first channel, when no free memory is available in said buffer memory ~~(13)~~.

8. (Amended) A method according to claim 6 ~~or 7~~, wherein said dropping of said predetermined data packet is inhibited and said new data packet is dropped, if the queue of said second channel has reached said upper buffer memory limit.

9. (Amended) A method according to claim 8 ~~any one of claims 6 to 8~~, wherein said channel with the longest packet queue is determined by an estimation.

11. (Amended) A method according to claim 10 ~~any one of the preceding claims~~, wherein said buffer means is a PDCP buffer ~~(13)~~.

12. (Amended) A method according to claim 11 ~~any one of the preceding claims~~, wherein said packet data connections are connections between mobile terminals (MT1-MTn) and Internet hosts (H1-Hn), or between mobile terminals.

15. (Amended) A method according to claim 14 ~~any one of claims 13 to 14~~, further comprising the step of admitting a new data flow only if the nominal flow rate of said new data flow falls within the remaining system bandwidth.

17. (Amended) A method according to claim 16 ~~any one of claims 13 to 16~~, wherein said method is used in a QoS scheduling algorithm for scheduling concurrent user traffic.

20. (Amended) A method according to claim 18 ~~or 19~~, wherein said first and second flow portions belong to different data flows scheduled on the same round.

21. (Amended) A method according to claim 18 ~~or 19~~, wherein said first and second portions belong to the same data flow, and said first flow portion is scheduled on a round following the round of said second flow portion.

22. (Amended) A method according to claim 18 ~~or 19~~, wherein said first and second flow portions belong to different data flows, and said first flow portion is scheduled on a round following the round of said second flow portion.

23. (Amended) A method according to claim 22 ~~any one of claims 13 to 22~~, wherein said nominal flow rate is determined based on the following equation:

$$NR_i = \alpha \times Cr_i$$

wherein α denotes a fractional value defining a tradeoff between an overall packet loss ratio and a system throughout, NR_i denotes a nominal flow rate assigned to a concerned user data flow i, and Cr_i denotes a contracted data rate for said concerned user data flow i.

24. (Amended) A method according to claim 23 ~~any one of claims 13 to 23~~, wherein an urgency factor is assigned to each data packet, and the target flow for said shift of said free capacity is determined based on said urgency factor.

25. (Amended) A method according to claim 23 ~~any one of claims 13 to 23~~, wherein an accumulated residual bandwidth is determined for each data flow, and the target flow for said shift of said free capacity is determined based on said accumulated residual bandwidth.

26. (Amended) A method according to claim 25 ~~any one of claims 13 to 25~~, wherein arriving data packets are segmented into data segments and scheduling is performed at the data segment level.

27. (Amended) A network for controlling a data packet flow in a buffer means ~~(13; 14)~~ of said network node, wherein said network node comprises flow control means ~~(11; 14)~~ for assigning a nominal capacity to each data flow, and for shifting free capacity from a first flow portion to a second flow portion when a new data packet of said second flow portion has been received at said buffer means ~~(13;14)~~ and said nominal capacity has been exceeded.

28. (Amended) A network node according to claim 27, wherein said buffer means comprises a buffer memory ~~(13)~~ shared between a plurality of channels allocated to respective packet data connections; and said flow control means comprises buffer control means ~~(11)~~ for determining an upper buffer memory limit for each channel in dependence on the number of allocated packet data connections and for controlling allocating means ~~(12)~~ so as to shift memory space allocated to a first channel from said first channel to a second

channel, when a new data packet of said second channel has been received and not enough memory space is available for said second channel.

29. (Amended) A network node according to claim 28, wherein said buffer control means ~~(11)~~ is arranged to determine said upper memory limit by dividing the total buffer memory capacity by the number of allocated channels.

30. (Amended) A network node according to claim 28 ~~or 29~~, wherein said buffer control means ~~(11)~~ is arranged to select a channel with the longest packet queue as said first channel and to control said allocating means ~~(12)~~ so as to drop a predetermined data packet from the queue of said first channel when no free memory is available in said buffer memory ~~(13)~~.

31. (Amended) A network node according to claim 30, wherein said buffer control means ~~(11)~~ is arranged to inhibit said dropping of said predetermined packet and to control said allocating means ~~(12)~~ to drop said new data packet, if the queue of said second channel has reached said upper buffer memory limit.

32. (Amended) A network node according to claim 30 ~~or 31~~, wherein said buffer control means ~~(11)~~ is arranged to estimate said channel with the longest packet queue by storing the length and identity of the last determined longest queue, to compare the length of a current queue with said stored longest queue on a queuing event, and to update the length and identity of said stored longest queue according to the result of comparison.

33. (Amended) A network node according to claim 32 ~~any one of claims 28 to 32~~, wherein said buffer memory is a PDCP buffer ~~(13)~~.

34. (Amended) A network node according to claim 27, wherein said flow control means comprises scheduling means ~~(14)~~ and said nominal capacity is a nominal flow rate at which data flow traffic is guaranteed in a QoS scheduling algorithm.

35. (Amended) A network node according to claim 34, wherein said scheduling means ~~(14)~~ comprises said buffer means.

36. (Amended) A network node according to claim 35 ~~any one of claims 27 to 35~~, wherein said network node is a radio network controller ~~(10)~~.